What is claimed is:

1. An apparatus for use in a mass spectrometer to enhance the performance thereof, said apparatus comprising:

means for detecting sample ions;

means for trapping sample ions; and

a differential amplifier;

wherein a space encompassed by said detecting means is also encompassed by said trapping means;

wherein said sample ions are trapped within said space by said trapping means by application of electrical potentials onto said trapping means; and

wherein said sample ions are detected by said detecting means.

2. An apparatus according to claim 1, wherein said means for detecting sample ions is arranged in a substantially cylindrical manner.

3. An apparatus according to claim 1, wherein said detecting means utilizes charge induction to detect ions.

4. An apparatus according to claim 1, wherein said sample ions are detected in a manner similar to that in an FTICR mass spectrometer.

5. An apparatus according to claim 1, wherein said trapping means comprises four RF electrodes.

6. An apparatus according to claim 1, wherein said detection means comprises four detection electrodes.

7. An apparatus according to claim 1, wherein said apparatus is linear.

8. A multipole device according to claim 1, wherein elements of said trapping means are held at a DC potential to trap ions within said detecting means.

9. A multipole device for transferring, trapping and analyzing ions in a mass spectrometer, said multipole device comprising:

a plurality of electrodes, said electrodes comprising a plurality of RF electrodes, and at least one first; and

second detection electrodes;

at least two trapping electrodes; and

a differential amplifier having first and second inputs;

wherein said plurality of electrodes are arranged such that no two RF electrodes are adjacent and no two detection electrodes are adjacent;

wherein all of said first detection electrodes are electrically connected and all of said second detection electrodes are electrically connected;

wherein said first detection electrodes are connected to said first input and said second detection electrodes are connected to said second input;

wherein one of said trapping electrodes is positioned at each end of said plurality of electrodes such that when an

appropriate DC potential is applied thereto said ions become trapped within said plurality of electrodes; and

wherein said differential amplifier measures the potentials on said detection electrodes to determine the m/z ratio of said ions.

10. A multipole device according to claim 9, wherein said plurality of electrodes are arranged in a substantially circular manner.

11. A multipole device according to claim 9, wherein said plurality of electrodes detect trapped ions by charge induction.

12. A multipole device according to claim 9, wherein said plurality of electrodes detect ions in the manner of FTICR mass spectrometry.

13. A multipole device according to claim 9, wherein said apparatus contains four RF electrodes, and four detection electrodes.

14. A multipole device according to claim 9, wherein said device is linear.

15. A multipole device according to claim 9, wherein said RF electrodes of said device have the same potential and frequency as said trapping electrodes.

16. A multipole device according to claim 9, wherein said device is further comprised of a single set of said RF electrodes, and said detection electrodes divide the multipole device into an analyzing section positioned between two trapping sections.

17. A multipole device according to claim 16, wherein said detection electrodes in said trapping sections are held at a DC potential to trap ions in said analyzing section.

18. A linear multipole device for transferring, trapping and analyzing ions in a mass spectrometer, said multipole device comprising:

four RF electrodes;

four electrodes comprising two first and two second detection electrodes;

two trapping electrodes; and

a differential amplifier having first and second inputs;

wherein said electrodes are arranged such that no two RF electrodes are adjacent and no two detection electrodes are adjacent;

wherein both of said first detection electrodes are electrically connected and both of said second detection electrodes are electrically connected;

wherein said first detection electrodes are connected to said first input and said second detection electrodes are connected to said second input;

wherein one of said trapping electrodes is positioned at each end of said electrodes such that when an appropriate DC potential is applied thereto said ions become trapped within said

plurality of electrodes; and

wherein said differential amplifier measures the potentials on said detection electrodes to determine the m/z ratio of said ions.

19. A linear multipole device according to claim 18, wherein all of said electrodes are circularly arranged.

20. A linear multipole device according to claim 18, wherein said detection electrodes detect trapped ions by charge induction.

21. A linear multipole device according to claim 18, wherein said detection electrodes detect said ions in the manner of FTICR mass spectrometry.

22. A linear multipole device according to claim 18, wherein said RF electrodes have the same potential and frequency as said trapping electrodes.

23. A linear multipole device according to claim 18, wherein said detection electrodes divide said device into three sections comprising one analyzing section located between two trapping sections.

24. A method for analyzing ions in a mass spectrometer, said method comprising the steps of:

directing ions into a multipole device having an analysis region positioned between, and coaxially with, first and second trapping regions;

trapping said ions within said analysis region by creating electric fields across said trapping regions; and

analyzing said ions;

wherein said analyzing region includes exciting said ions within said analysis region and detecting said ions from within said analysis region.

25. A method according to claim 24, wherein said ions are detected within said analysis region by a plurality of detection electrodes.

26. A method according to claim 25, wherein said plurality of detection electrodes comprises four detection electrodes, allowing detection of said excited, ions in two cycles.

27. A method according to claim 24, wherein said trapping regions are held at a higher DC potential than said analysis region to form a substantially homogeneous quadrupolar field within said analysis region.

28. A method according to claim 24, wherein said exciting is achieved by applying an electrical pulse between electrodes of said analysis region.

29. A method according to claim 28, wherein said exciting causes said ions to move in a substantially circular orbit around a central axis of said analysis region.

30. A method according to claim 28, wherein said exciting causes said ions to move in a substantially oval orbit around a central axis of said analysis region.

31. A method according to claim 24, wherein said ions are detected using charge induction.

32. A method according to claim 24, wherein said ions are detected in the manner of FTICR mass spectrometry.

33. A mass analyzer comprising:

at least four RF electrodes;

at least four detect electrodes; and

at least two DC electrodes;

wherein said RF electrodes and detect electrodes are arranged in a cylindrically symmetric manner about a central axis;

wherein said RF electrodes and detect electrodes have inner surfaces which are arc shaped;

wherein every RF electrode is arranged between and parallel with two detect electrodes;

wherein every detect electrode is arranged between and parallel with two RF electrodes;

wherein sample ions are substantially trapped on the axis of said mass analyzer by the action of an RF electric field generated via said RF electrodes;

wherein said sample ions are substantially prevented from exiting the ends of said mass analyzer by the action of a DC electric field generated via said DC electrodes; and

wherein said detect electrodes are used to detect the ions in said mass analyzer.

34. An apparatus according to claim 33, wherein said detecting means utilizes charge induction to detect ions.

35. An apparatus according to claim 33, wherein at least some of said RF electrodes, DC electrodes, or detect electrodes extend through a pumping restriction.

36. An apparatus according to claim 33, wherein at least some of said RF electrodes, DC electrodes, or detect electrodes are used to assist in the transport of ions from an ion source into said mass analyzer.

37. An apparatus according to claim 35, wherein said electrodes which extend through said pumping restriction are used in part to assist in the transport of ions from an ion source into said mass analyzer.